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April 5, 1999

SEE ATTACHED LIST

You have been selected as a recipient of this letter because you are identified as a User, Developer or Integrator of Title 21 Compliant Automatic Vehicle Identification equipment, most commonly used in Electronic Toll Collection (ETC) applications.

Title 21 compliant equipment is based upon an open standard developed by the California Department of Transportation (Caltrans). The standard was developed with ETC specifically identified as an initial application, but also defined a framework to enhance and define new applications based upon this technology.

California law mandates the use of Title 21 compliant equipment for all ETC applications, and there currently is interoperability between the different toll agencies in the State. Statewide interoperability is achieved because each of the agencies utilizes Title 21 compliant equipment and participates in a data registration process within the State. Caltrans currently is the agency responsible for the maintenance and data registration of the standard.

It is the intent of this letter to solicit your participation to complete the data registration of the Title 21 standard within California and to extend the process to include Title 21 facilities outside of California, related equipment manufacturers and system integrators.

Participation in Caltrans' Title 21 data registration process will help ensure the system viability and protect your interests as the standard matures and market forces respond with new products. The registration process and record maintenance can provide a mechanism for different data assignments to remain unique, and the foundation for regional and interregional interoperability. Additionally, the consolidation of Title 21 data assignments should facilitate an interoperable transition to the National Dedicated Short-Range Communication standard when appropriate.

Enclosed is background information about the Title 21 standard, including current assignments within California. Additionally, there is a data registration information request form to complete and return in the provided envelope. This information request form is intended to be filled out by a technical person familiar with the communication protocols of your Title 21 based system.

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Please feel free to contact Mr. David Cordone, of my staff at (916) 653-4670 for any technical assistance in completing the form. Thank you in advance for your participation.

Sincerely,

A handwritten signature in black ink, appearing to read "Hamed Benouar", with a stylized flourish at the end.

HAMED BENOUAR
Program Manager
Traffic Operations

Enclosures

- Barclays California Code of Regulations for the Title 21 Standard
- California's Definition for Title 21's Transponder ID Number Field
- Caltrans Approved Title 21 Transaction Record Type Codes
- Title 21 Data Registration Survey Form/Return Envelope

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Article 5. Project Funding

§ 1676. Project Funding.

Funds made available for projects under subsections (b) and (c) of Section 1670 may be used for public transportation projects which are included in a State program of projects for public transportation in areas other than urbanized areas. The Federal share for any construction or capital project under this Section shall not exceed eighty percent (80%) of the net cost of such construction or capital project. The Federal share for any project for the payment of financial assistance for operating expenses as defined by the United States Department of Transportation shall not exceed fifty percent (50%) of the net cost of such operating expense project. At least fifty percent (50%) of the remainder of the net cost for both capital and operating projects shall be provided in cash, or cash equivalent from sources other than Federal funds or revenues from the operation of public mass transportation systems. Up to fifty percent (50%) of the remainder of the net cost may be made up of unrestricted funds from other Federal programs.

NOTE: Authority cited: Section 14031, Government Code; and Section 18 of the Urban Mass Transportation Act of 1964 (49 USC 1614). Reference: Section 14031, Government Code; Section 18 of the Urban Mass Transportation Act of 1964 (49 USC 1614); and Urban Mass Transportation Administration Circular 9040.1.

HISTORY

Amendment filed 1-17-85; effective thirtieth day thereafter (Register 85, No. 3).

§ 1677. Use of Other Federal Funds.

Applicants that have used funds pursuant to Section 5 or Section 9 of the Urban Mass Transportation Act in the past for services that extend into nonurbanized areas shall continue to use these Section 5 or Section 9 funds for these purposes as long as the services are appropriate for the area. Section 18 funds shall be used only for new or expanded services in these nonurbanized areas.

NOTE: Authority cited: Section 14031, Government Code; and Section 18 of the Urban Mass Transportation Act of 1964 (49 USC 1614). Reference: Section 14031, Government Code; Section 18 of the Urban Mass Transportation Act of 1964 (49 USC 1614); and Urban Mass Transportation Administration Circular 9040.1

HISTORY

Amendment filed 1-17-85; effective thirtieth day thereafter (Register 85, No. 3).

Article 6. Planning

NOTE: Authority cited: Sections 14031 and 14033, Government Code. Reference: Sections 14031 and 14033, Government Code.

HISTORY

1. Repealer of Article 6 (Sections 1678 and 1679) filed 1-17-85; effective thirtieth day thereafter (Register 85, No. 3).

Article 7. Programming

NOTE: Authority cited: Sections 14031 and 14033, Government Code. Reference: Sections 14031 and 14033, Government Code.

HISTORY

1. Repealer of Article 7 (Sections 1680 and 1681) filed 1-17-85; effective thirtieth day thereafter (Register 85, No. 3).

Article 8. Implementation

NOTE: Authority cited: Sections 14031 and 14033, Government Code. Reference: Sections 14031 and 14033, Government Code.

HISTORY

1. Repealer of Article 8 (Sections 1685 and 1686) filed 1-17-85; effective thirtieth day thereafter (Register 85, No. 3).

Article 9. Accounting, Reporting, and Auditing

NOTE: Authority cited: Sections 14031 and 14033, Government Code. Reference: Sections 14031 and 14033, Government Code.

HISTORY

1. Repealer of Article 9 (Sections 1688 and 1689) filed 1-17-85; effective thirtieth day thereafter (Register 85, No. 3).

Article 10. Settlement of Conflicts

NOTE: Authority cited: Sections 14031 and 14033, Government Code. Reference: Sections 14031 and 14033, Government Code.

HISTORY

1. Repealer of Article 10 (Section 1690) filed 1-17-85; effective thirtieth day thereafter (Register 85, No. 3).

Chapter 16. Compatibility Specifications for Automatic Vehicle Identification Equipment

Article 1. Summary of Key Compatibility Specifications for Automatic Vehicle Identification Equipment

§ 1700. Summary.

The compatibility specifications for automatic vehicle identification (AVI) equipment have been developed around two principal components: a reader and a transponder. The minimum role of the reader is to:

- 1) trigger or activate a transponder.
- 2) poll the transponder for specific information, and
- 3) provide an acknowledge message to the transponder after a valid response to the polling message has been received.

A half-duplex communications system is envisioned where the transponder takes its cues from the reader.

The specification is meant to define a standard two way communications protocol and to further define an initial set of data records.

A summary of the key compatibility specifications found in this Chapter are set forth below:

Reader Specifications:	
Reader Trigger Signal	33 microseconds of unmodulated RF
Reader Send Mode (Downlink)	
Carrier Frequency:	915 ± 13 MHz (subject to FCC assignment)
Carrier Modulation:	Unipolar ASK (Manchester Encoded)
Data Bit Rate:	300 kbps
No. Data Bits:	Application Specific
Field Strength	
at Transponder Antenna:	500 mV/m (minimum)
Transponder Specifications:	
Technology Type:	Modulated Backscatter
Transponder Antenna Polarization:	Horizontal
Field-of-View:	Operation within 90° conical angle
Location:	Front of Vehicle
Transponder Send Mode (Uplink)	
Carrier Frequency:	Same as Reader Send Mode
Carrier Modulation:	Subcarrier AM
Subcarrier Modulation:	FSK
Subcarrier Frequencies:	600 kHz ± 10% and 1200 kHz ± 10%
Data Bit Rate:	300 kbps
No. Data Bits:	Application Specific
Receiver Field-Strength	
Threshold:	500 mV/m ± 50 mV/m (minimum)

NOTE: All mV/m specifications are in RMS voltage.

NOTE: Authority cited: Section 27565, Streets and Highways Code. Reference: Sections 27564 and 27565, Streets and Highways Code.

HISTORY

1. New chapter 16, articles 1-4 and sections 1700-1705.8, not consecutive filed 6-26-92; operative 7-27-92 (Register 92, No. 26).

2. Amendment filed 5-1-98; operative 5-31-98 (Register 98, No. 18).

§ 1701. Definition of Technical Terms.

The following are definitions of technical terms used throughout this Chapter:

- (a) AM – Amplitude modulation
- (b) ASK – Amplitude shift keying
- (c) BCC – Block check character
- (d) CRC – Cyclic redundancy check
- (e) CW – Continuous wave
- (f) EIRP – effective isotropically radiated power = gain x net power
- (g) EM – Electromagnetic
- (h) FCC – Federal Communications Commission
- (i) FSK – Frequency-shift keying
- (j) ID – Device identification
- (k) kbps – kilobits per second
- (l) kHz – kilohertz (10^3 hertz)
- (m) kph – kilometer per hour
- (n) MHz – megahertz
- (o) m/Vm – milliVolts/meter
- (p) Reader – A fixed-position reader, associated transmit and receive (Tx/Rx) antenna(s), and modulation and demodulation hardware and software.

- (q) RF – Radio frequency
- (r) Transponders – Electronic devices that contain information which can be communicated to the reader. The transponders may have the capability to read and write information.

NOTE: Authority cited: Section 27565, Streets and Highways Code. Reference: Sections 27564 and 27565, Streets and Highways Code.

HISTORY

1. New section filed 6-26-92; operative 7-27-92 (Register 92, No. 26).
2. Amendment of subsections (c)–(e), new subsection (o), subsection relettering, and amendment of newly designated subsection (r) filed 5-1-98; operative 5-31-98 (Register 98, No. 18).

Article 2.0. Introduction

§ 1702.1. Objectives.

This chapter defines the compatibility requirements for automatic vehicle identification (AVI) equipment. Supplemental agency (e.g., toll authority) specifications will detail the technical, environmental, and operational specifics for each site implementation. The immediate mandate for this compatibility specification is for electronic toll collection.

AVI equipment will essentially consist of two functional elements: vehicle-mounted transponders and fixed-position reader units.

The specification is meant to define a standard communications protocol and to further define an initial set of data records. The initial data records are designed for voluntary implementations of electronic toll collection.

It is further envisioned that more complex data records will be developed to handle anonymous transactions, secure funds transfers, information transfers, and other transactions between the reader and the transponder that will be defined as needed. The transponders may have the capability to read and write information. Caltrans shall function as the standards monitoring authority to authorize the use of new record types and to assign record type numbers to newly authorized records. Caltrans shall pass this responsibility to an appropriate standards setting organization when one is established and recognized with Caltrans retaining representation in the standards setting organization.

Nothing in these regulations shall preclude the addition of functions and technologies to the transponder and/or reader systems.

NOTE: Authority cited: Section 27565, Streets and Highways Code. Reference: Sections 27564 and 27565, Streets and Highways Code.

HISTORY

1. New section filed 6-26-92; operative 7-27-92 (Register 92, No. 26).
2. Amendment adding last sentence filed 2-16-93; operative 3-18-93 (Register 93, No. 8).
3. Amendment of first and fourth paragraphs filed 5-1-98; operative 5-31-98 (Register 98, No. 18).

§ 1702.2. Organization.

This chapter consists of four articles. An overview and summary of the key specifications is given in Article 1. Article 2 presents the objectives and definitions for data codes. Articles 3 and 4 provide specifications unique to the reader and transponder respectively.

NOTE: Authority cited: Section 27565, Streets and Highways Code. Reference: Sections 27564 and 27565, Streets and Highways Code.

HISTORY

1. New section filed 6-26-92; operative 7-27-92 (Register 92, No. 26).

§ 1703. Definitions for Data Codes.

(a) Agency Code: This 16-bit code field identifies the agency that has authority to conduct the transaction.

(b) Byte Order: Numeric fields shall be transmitted most significant bit first. If a numeric field is represented as multiple bytes, the most significant bit of the most significant byte is transmitted first. This document represents the most significant and first transmitted to the left on a line and to the top of a multi line tabulation.

(c) Error Detection Code: The error detection code utilized in the defined records is the CRC-CCITT, with a generator polynomial of $X^{16}+X^{12}+X^5+1$. This results in a 16-bit BCC transmitted with each data message. The data field protected by the CRC excludes any preceding header in every case.

(d) Filler Bits: Filler bits are used to adjust the data message length to a desired length and shall be set to zero.

(e) Header Code: The header is the first field in each data message for either reader or transponder transmissions and consists of an 8-bit and a 4-bit word for a total of 12 bits. The header provides a signal that may be used by a receiver to self-synchronize (selsyn) with the data being transmitted, thus the notation selsyn. The selsyn signal has binary and hexadecimal values: 10101010 and AA, respectively.

The header code also provides for a unique, 4 bit flag that is recognized by a receiver decoder as the end of the header with the data message to follow. The flag signal has binary and hexadecimal values: 1100 and C respectively.

(f) Reader ID Number: This 32-bit field is used to uniquely identify the reader conducting the transaction.

(g) Transaction Record Type Code: This 16-bit code uniquely identifies a specific type of valid transaction between a reader and a transponder. This code uniquely defines the transponder message fields and functions permissible with the transaction type specified by the polling message as described in Section 1704.5(e)(1). Hexadecimal numbers 1 through 7FFF are set aside for transponder message structures and 8000 through FFFF are dedicated for reader-to-transponder message structures.

(h) Transaction Status Code: Used to provide status information to the transponder.

(i) Transponder ID Number: This 32-bit code uniquely identifies which transponder is responding to a polling request or is being acknowledged.

NOTE: Authority cited: Section 27565, Streets and Highways Code. Reference: Sections 27564 and 27565, Streets and Highways Code.

HISTORY

1. New section filed 6-26-92; operative 7-27-92 (Register 92, No. 26).
2. Amendment of subsections (a), (c), (e) and (g) filed 5-1-98; operative 5-31-98 (Register 98, No. 18).

Article 3. Reader Specifications

§ 1704.1. General.

The reader will transmit a RF trigger pulse to activate (turn-on) the transponders. After a time delay, the reader then will transmit an encoded signal, referred to as the polling message which, upon detection and decoding by the transponder, will provide initial information to the transponder including the type of transaction the reader wishes to conduct.

The reader will then transmit an unmodulated CW RF signal for the transponder to modulate with a data message while backscattering to the reader. The reader may repeat the polling-to-backscattering sequence

until it obtains an error free data message from the transponder. The reader will then transmit an encoded acknowledge message to the transponder providing status information and requesting that the transponder not respond to the same polling message again for a fixed time period.

NOTE: Authority cited: Section 27565, Streets and Highways Code. Reference: Sections 27564 and 27565, Streets and Highways Code.

HISTORY

1. New section filed 6-26-92; operative 7-27-92 (Register 92, No. 26).
2. Amendment filed 5-1-98; operative 5-31-98 (Register 98, No. 18).

§ 1704.2. RF Carrier Frequency.

The RF carrier frequency shall be taken from the 915 MHz \pm 13 MHz range. Specific frequency and bandwidth depend upon pending FCC assignment.

NOTE: Authority cited: Section 27565, Streets and Highways Code. Reference: Sections 27564 and 27565, Streets and Highways Code.

HISTORY

1. New section filed 6-26-92; operative 7-27-92 (Register 92, No. 26).

§ 1704.3. Reader Antenna Specifications.

(a) Reader Antenna Polarizations.

The reader transmit and receive antennas shall have predominant EM field components that are co-polarized to the horizontal polarization specified for the transponder transmit and receive antennas in section 1705.3(a). Horizontal, linear, circular or elliptical polarizations are allowed.

(b) Reader Antenna Location.

The reader antenna location is site specific.

NOTE: Authority cited: Section 27565, Streets and Highways Code. Reference: Sections 27564 and 27565, Streets and Highways Code.

HISTORY

1. New section filed 6-26-92; operative 7-27-92 (Register 92, No. 26).
2. Amendment of subsection (a) filed 5-1-98; operative 5-31-98 (Register 98, No. 18).

§ 1704.4. Reader-to-Transponder Trigger Pulse.

(a) Trigger Pulse Definition.

The reader shall provide a wakeup trigger for the transponder. The trigger shall consist of a 33 microsecond long, RF pulse at the assigned carrier frequency that is modulated with a continuous string of ones. The trigger pulse shall be followed immediately by a delay (i.e., no RF transmission) of 100 microseconds duration. The wakeup pulse is intended to signal a dormant transponder to fully activate itself.

(b) Trigger Pulse Field Strength.

The required horizontal component of field strength produced by the trigger pulse at the maximum downlink range (site dependent) of the reader shall be greater than 500 mV/m.

NOTE: Authority cited: Section 27565, Streets and Highways Code. Reference: Sections 27564 and 27565, Streets and Highways Code.

HISTORY

1. New section filed 6-26-92; operative 7-27-92 (Register 92, No. 26).

§ 1704.5. Reader Communications Protocol.

(a) AM Modulation Scheme.

The downlink (reader-to-transponder) modulation scheme shall be unipolar ASK of the RF carrier using Manchester encoding. A data bit '1' is transmitted by sending an RF pulse during the first half of the bit period and no signal during the second half, while for a '0' data bit the reverse order is used; i.e., no signal during the first half of the bit period and an RF pulse transmission during the second half.

(b) Data Bit Rates.

The data bit rate for reader-to-transponder messages shall be 300 kbps.

(c) Field Strength.

The field strength of a reader data message at the transponder shall be greater than 500 mV/m.

(d) Standard Reader Data Message Format.

The standard portion of a reader data message shall consist of a header and transaction record type code. The subsequent length, data content,

and error detection scheme shall then be established by the definition for that transaction record type.

(e) Reader Data Message Formats for AVI.

There may be several reader-to-transponder data message formats. The format is determined by the transaction record type code sent by the reader. The following is the reader-to-transponder message format presently specified for AVI electronic toll collection applications:

(1) Reader Transaction Record Type 1 (Polling Message).

The polling message (which follows the 100 microsecond delay after the trigger signal) tells the transponder the type of transaction the reader wishes to conduct. For AVI electronic toll collection applications, reader transaction record type 1 (polling message) also would identify the agency or toll authority. For AVI applications, the reader-to-transponder type 1 polling message shall be structured using the following ordered data bit fields:

Field Definition	No. Bits	Hexadecimal Value
Header Code		
Selsyn	8	AA
Flag	4	C
Transaction Record Type Code	16	8000
Agency Code	16	
Error Detection Code	16	
Total: 60		

(2) Reader Transaction Record Type 2 (Acknowledge Message).

A reader-to-transponder acknowledge data message shall be provided to inform specific transponders that they have been successfully processed and to stop responding to further identical reader polling requests. The acknowledge message is used to terminate the transaction, and is only sent if the transaction is successfully completed. Reader transaction record type 2 (acknowledge message) shall consist of the following ordered data bit fields:

Field Definition	No. Bits	Hexadecimal Value
Header		
Selsyn	8	AA
Flag	4	C
Transaction Record Type Code	16	C000
Transponder ID Number	32	
Reader ID Number	32	
Transaction Status Code	16	
Error Detection Code	16	
Total: 124		

(f) Reader End-of-Message Frame.

The end-of-message signal for reader-to-transponder data messages shall consist of a minimum of 10 microseconds of no RF carrier signal. Transponder decoders shall have the ability to detect this condition as an invalid Manchester code.

NOTE: Authority cited: Section 27565, Streets and Highways Code. Reference: Sections 27564 and 27565, Streets and Highways Code.

HISTORY

1. New section filed 6-26-92; operative 7-27-92 (Register 92, No. 26).
2. Amendment of subsections (d)-(f) filed 5-1-98; operative 5-31-98 (Register 98, No. 18).

§ 1704.6. Reader Field Strength for Modulated Backscattering.

The electric field strength produced by a reader is a function of the EIRP. The EIRP required to detect a modulated backscattered RF signal from a transponder with a reasonably high signal-to-noise ratio is determined by the maximum range to the transponder and the detection sensitivity of the reader receiver plus any gain margin. If the overall gain characteristics of the transponder were held constant, the required EIRP then becomes site dependent.

The electric field strength to accomplish modulated backscattering is expected to be lower than that required for triggering a transponder or for sending a reader data message. Sensitive reader receivers likely will be necessary, however, such as that obtained with homodyne or heterodyne technology.

NOTE: Authority cited: Section 27565, Streets and Highways Code. Reference: Sections 27564 and 27565, Streets and Highways Code.

HISTORY

1. New section filed 6-26-92; operative 7-27-92 (Register 92, No. 26).

Article 4. Transponder Specifications

§ 1705.1. General Description.

Transponders will be encoded with unique identification data together with other coded data as described in this section. On passing through any AVI reader zone, the transponder will provide the coded data to the reader only on receipt of a valid reader polling command. Transponders must be capable of being turned on and off as specified herein. Transponders must be capable of two-way data communications. Transponders may be portable. The transponders may have the capability to read and write information.

NOTE: Authority cited: Section 27565, Streets and Highways Code. Reference: Sections 27564 and 27565, Streets and Highways Code.

HISTORY

1. New section filed 6-26-92; operative 7-27-92 (Register 92, No. 26).
2. Amendment filed 5-1-98; operative 5-31-98 (Register 98, No. 18).

§ 1705.2. Transponder RF Carrier Frequency.

The transponder RF carrier frequency in a backscatter system is identical to that used by the reader; the frequency will be in the range of 915 MHz \pm 13 MHz. The transponder shall be capable of operating over the full \pm 13 MHz band to allow site flexibility in reader implementation.

NOTE: Authority cited: Section 27565, Streets and Highways Code. Reference: Sections 27564 and 27565, Streets and Highways Code.

HISTORY

1. New section filed 6-26-92; operative 7-27-92 (Register 92, No. 26).

§ 1705.3. Transponder Transmit and Receive Antennas.

(a) Antenna Polarizations.

The transponder transmit and receive antennas shall have EM field components that are predominantly horizontally polarized transverse to normal traffic flow. Horizontal, linear, circular or elliptical polarizations are allowed.

(b) Antenna Field of Views.

The transponder transmit and receive antennas shall have a field of view which is a 90° cone in front of the vehicle. The projection of the horizontal component of the cone's axis shall be parallel to the lane and the vertical component of the cone's axis shall be 35° horizontal.

NOTE: Authority cited: Section 27565, Streets and Highways Code. Reference: Sections 27564 and 27565, Streets and Highways Code.

HISTORY

1. New section filed 6-26-92; operative 7-27-92 (Register 92, No. 26).
2. Amendment of subsection (a) filed 5-1-98; operative 5-31-98 (Register 98, No. 18).

§ 1705.4. Transponder Activation.

(a) Activation Timing.

Within 1 millisecond of entry into the reader's modulated RF field, a transponder shall be fully activated and ready to decode the polling message from the reader within 100 microseconds of receipt of a 33 microsecond long modulated RF trigger pulse from the reader.

(b) Activation Timing for Battery Power Management.

As an alternative to 1705.4(a), a delay of 20 additional milliseconds is permissible for a transponder using multiple-stage activation to conserve battery life. Within 21 milliseconds of entry into the reader's modulated RF field, such a transponder shall be fully activated and ready to decode the polling message from the reader within 100 microseconds of receipt of a 33 microsecond long modulated trigger pulse from the reader.

(c) Activation Field Strength.

The transponder receiver shall be capable of recognizing and acting on a trigger signal and polling message when the free-space field strength at the transponder location exceeds 550 mV/m and will not respond to field strengths below 450 mV/m (Electric field strengths are to be measured in free-space and in the absence of any vehicle). After completion of the polling message, the transponder shall begin modulating and backscattering RF with continuous zero bits. 100 microseconds after completion of the polling message, the transponder shall begin transmitting its

message. If a newly activated transponder does not immediately receive a polling message, it shall remain activated and ready to receive a subsequent reader message for at least 20 milliseconds.

NOTE: Authority cited: Section 27565, Streets and Highways Code. Reference: Sections 27564 and 27565, Streets and Highways Code.

HISTORY

1. New section filed 6-26-92; operative 7-27-92 (Register 92, No. 26).
2. Repealer and new section filed 5-1-98; operative 5-31-98 (Register 98, No. 18).

§ 1705.5. Transponder Communications Protocol.

(a) Subcarrier Modulation Scheme.

The transponder-to-reader (uplink) modulation scheme shall be amplitude modulation of an RF carrier backscatter created by varying the reflecting crosssection of the antenna as seen by the incident carrier signal. The antenna crosssection shall be varied between upper and lower limits with a 50 percent duty cycle and rise and fall times of less than 75 nanoseconds. The transponder baseband message signal shall modulate the subcarrier using FSK modulation with a center frequency of 900 kHz and frequency deviation of \pm 300 kHz. The lower and upper subcarrier frequencies correspond to data bits '0' and '1' respectively. The message information is conveyed by the subcarrier modulation frequencies of the transponder backscattered signal and not by amplitude or phase.

(b) Data Bit Rates.

The data bit rate for transponder-to-reader data messages shall be 300 kbps.

(c) Field Strength.

The field strength at which a transponder data message is transmitted using backscatter technology is dependent upon the incident field strength from the reader, the transponder receive and transmit antenna gains, and any RF gain internal to the transponder. The transponder and antenna gain taken together shall effect a change in the backscattering cross section of between 45 and 100 square centimeters.

(d) Standard Transponder Data Message Format.

The standard portion of a transponder data message shall consist of a header and transaction record type code. The subsequent length, data content, and error detection scheme shall then be established by the definition for that transaction record type.

(e) Transponder Data Message Formats for AVI Toll Collection.

There may be numerous transponder-to-reader data message formats. The format is determined by the transaction record type code sent by the transponder. The following is the reader-to-transponder message format presently specified for AVI electronic toll collection applications:

(1) Transponder Transaction Type 1 (Data Message).

Transponder transaction type 1 (data message) allows for unencrypted transponder ID numbers to be transmitted. Type 1 (data messages) shall be structured using the following ordered data bit fields:

Field Definition	No. Bits	Hexadecimal Value
Header Code		
Selsyn	8	AA
Flag	4	C
Transaction Record Type Code	16	1
Transponder ID Number	32	
Error Detection Code	16	
Total:	76	

(f) Transponder End-of-Message Frame

The End-of-Message signal for transponder data messages shall consist of a minimum of 10 microseconds of no modulation.

NOTE: Authority cited: Section 27565, Streets and Highways Code. Reference: Sections 27564 and 27565, Streets and Highways Code.

HISTORY

1. New section filed 6-26-92; operative 7-27-92 (Register 92, No. 26).
2. Amendment of subsections (d)-(e)(1) filed 5-1-98; operative 5-31-98 (Register 98, No. 18).

§ 1705.6. Transponder Response to Reader Acknowledge Message.

The transponder shall discontinue responding to identical reader polling requests for a period of 10 seconds once a valid reader acknowledgement message has been received. The transponder shall, however, re-

spond to polling messages that are not identical to the polling message that lead to the valid acknowledgement.

NOTE: Authority cited: Section 27565, Streets and Highways Code. Reference: Sections 27564 and 27565, Streets and Highways Code.

HISTORY

1. New section filed 6-26-92; operative 7-27-92 (Register 92, No. 26).
2. Amendment filed 5-1-98; operative 5-31-98 (Register 98, No. 18).

§ 1705.7. Multiple Transponder Responses to a Reader Polling Message.

Each transponder data message transmittal must be in response to a reader polling message.

NOTE: Authority cited: Section 27565, Streets and Highways Code. Reference: Sections 27564 and 27565, Streets and Highways Code.

HISTORY

1. New section filed 6-26-92; operative 7-27-92 (Register 92, No. 26).

§ 1705.8. Transponder Positioning.

Transponders shall be positioned at the front of the vehicle with a clear line of sight to the reader antenna without degrading the performance of the reader-transponder system below minimum specified standards. As a minimum, transponders shall operate up to a maximum of 76cm (30") offset from the longitudinal center line of the vehicle.

The front of the vehicle shall be defined as that portion of the vehicle from the driver's eyes forward.

NOTE: Authority cited: Section 27565, Streets and Highways Code. Reference: Sections 27564 and 27565, Streets and Highways Code.

HISTORY

1. New section filed 6-26-92; operative 7-27-92 (Register 92, No. 26).

Chapter 18. Junkyard Control

Article 1. General

§ 2000. Authority.

NOTE: Authority cited: Section 759, Streets and Highways Code. Reference: Sections 746(g), 746.3 and 759, Streets and Highways Code.

HISTORY

1. New Subchapter 18 (Articles 1-4, Sections 2000-2041, not consecutive) filed 3-11-80; effective thirtieth day thereafter (Register 80, No. 11).
2. Order of Repeal filed 8-26-82 by OAL pursuant to Government Code Section 11349.7(j) (Register 82, No. 35).

§ 2001. Application Zone.

NOTE: Authority cited: Section 759, Streets and Highways Code. Reference: Sections 746(f), (h), (i), and 747, Streets and Highways Code.

HISTORY

1. Repealer filed 9-16-96; operative 10-16-96 (Register 96, No. 38).

Article 2. Definitions

§ 2010. Automobile Wrecker/Autowrecking Yard.

NOTE: Authority cited: Section 759, Streets and Highways Code. Reference: Sections 746(e), 746.3 and 759, Streets and Highways Code.

HISTORY

1. Repealer of article 2 (sections 2010-2016) and section filed 9-16-96; operative 10-16-96 (Register 96, No. 38).

§ 2011. Highway.

NOTE: Authority cited: Section 759, Streets and Highways Code. Reference: Sections 746(f), (h), (i), Streets and Highways Code.

HISTORY

1. Repealer filed 9-16-96; operative 10-16-96 (Register 96, No. 38).

§ 2012. Highway Beautification Easement.

NOTE: Authority cited: Section 759, Streets and Highways Code. Reference: Sections 751, 751.1 and 752, Streets and Highways Code.

HISTORY

1. Repealer filed 9-16-96; operative 10-16-96 (Register 96, No. 38).

§ 2013. Owner.

NOTE: Authority cited: Section 759, Streets and Highways Code. Reference: Sections 745-759.3, Streets and Highways Code.

HISTORY

1. Repealer filed 9-16-96; operative 10-16-96 (Register 96, No. 38).

§ 2014. Proprietor.

NOTE: Authority cited: Section 759, Streets and Highways Code. Reference: Sections 745-759.3, Streets and Highways Code.

HISTORY

1. Repealer filed 9-16-96; operative 10-16-96 (Register 96, No. 38).

§ 2015. Screening.

NOTE: Authority cited: Section 759, Streets and Highways Code. Reference: Sections 747.1, 748, 749, 751 and 755, Streets and Highways Code.

HISTORY

1. Repealer filed 9-16-96; operative 10-16-96 (Register 96, No. 38).

§ 2016. Visible.

NOTE: Authority cited: Section 759, Streets and Highways Code. Reference: Section 746.3, Streets and Highways Code.

HISTORY

1. Repealer filed 9-16-96; operative 10-16-96 (Register 96, No. 38).

Article 3. Procedure

§ 2030. Industrial Zone Exception.

NOTE: Authority cited: Section 759, Streets and Highways Code. Reference: Sections 746.3 and 747, Streets and Highways Code.

HISTORY

1. Repealer of article 3 (sections 2030-2038) and section filed 9-16-96; operative 10-16-96 (Register 96, No. 38).

§ 2031. Legal Yard.

NOTE: Authority cited: Section 759, Streets and Highways Code. Reference: Section 749, Streets and Highways Code.

HISTORY

1. Repealer filed 9-16-96; operative 10-16-96 (Register 96, No. 38).

§ 2032. Industrial Zone.

NOTE: Authority cited: Section 759, Streets and Highways Code. Reference: Section 747, Streets and Highways Code.

HISTORY

1. Repealer filed 9-16-96; operative 10-16-96 (Register 96, No. 38).

§ 2033. Illegal Yard.

NOTE: Authority cited: Section 759, Streets and Highways Code. Reference: Sections 746.3 and 747, Streets and Highways Code.

HISTORY

1. Repealer filed 9-16-96; operative 10-16-96 (Register 96, No. 38).

§ 2034. Procedure.

NOTE: Authority cited: Section 759, Streets and Highways Code. Reference: Sections 754, 755, 756 and 757, Streets and Highways Code.

HISTORY

1. Repealer filed 9-16-96; operative 10-16-96 (Register 96, No. 38).

§ 2035. Curing Illegality.

NOTE: Authority cited: Section 759, Streets and Highways Code. Reference: Sections 746.3 and 747, Streets and Highways Code.

HISTORY

1. Repealer filed 9-16-96; operative 10-16-96 (Register 96, No. 38).

§ 2036. Nonconforming Yard.

NOTE: Authority cited: Section 759, Streets and Highways Code. Reference: Sections 748 and 749, Streets and Highways Code.

HISTORY

1. Repealer filed 9-16-96; operative 10-16-96 (Register 96, No. 38).

§ 2037. Configuration.

NOTE: Authority cited: Section 759, Streets and Highways Code. Reference: Sections 746(a), 746.1, 746.2 and 748, Streets and Highways Code.

HISTORY

1. Repealer filed 9-16-96; operative 10-16-96 (Register 96, No. 38).

§ 2038. Cessation.

NOTE: Authority cited: Section 759, Streets and Highways Code. Reference: Section 746.2, Streets and Highways Code.

CALIFORNIA'S DEFINITION FOR TITLE 21'S 32-BIT TRANSPONDER ID NUMBER FIELD

In the State of California, the 32-bit Transponder ID Number Field specified in the Title 21 standard has been further subdivided into three data fields to represent Tag Type, Facility Code, and Internal Tag ID. These fields are currently defined as follows:

32-bit Transponder ID Number Field		
<i>TAG TYPE</i>	<i>FACILITY CODE</i>	<i>INTERNAL TAG ID</i>
4 Bits	18 Bits	10 Bits
16 Possibilities	262,144 Possibilities	1,024 Possibilities
Most Significant Bit		Least Significant Bit

Tag Type

A 4-bit field used to determine the behavior of the transponder, such as whether it is a read only tag or a read/write tag. Currently, the 4-bit field is defined in decimal notation as follows:

- 0 -READ ONLY
- 0-15 -Unassigned. For Future Use.

Facility Code

An 18-bit field used to identify the facility or entity conducting business. Facility Code ranges are assigned based upon the number of transponders that are projected to be utilized. Currently this 18-bit field is defined in decimal notation as follows:

Facility Codes		
<i>Agency</i>	<i>Facility Codes Assigned</i>	<i>No. of Transponders</i>
State of California	0 – 131,071	134,217,728
TCA	131,072 – 132,092	1,045,504
SR-91	132,096 – 132,607	524,288
SANDAG I-15	132,992 – 133,001	10,240
Golden Gate Bridge	133,015 – 133,407	402,432
CTV	134,583 – 134,876	301,056
SENTRI	184,876 – 185,022	150,528
SANDAG I-15	258,991 – 259,014	24,576
Caltrans ATCAS	260,096 – 261,116	1,045,504

Internal Tag ID

A 10-bit field used to refer to the unique identification numbers that belong to an assigned Facility Code. For each Facility Code, a block of 1,024 Internal Tag IDs will be assigned within the Transponder ID Number Field. Assignment of the Internal Tag ID's is the responsibility of the Facility Code Agency.

CALTRANS APPROVED TITLE 21 TRANSACTION RECORD TYPE CODES

BACKGROUND

In 1990 the California State legislature directed the California Department of Transportation (Caltrans) to develop specifications and standards for an Automatic Vehicle Identification system such that a vehicle owner would not have to install more than one device to use toll facilities statewide.

Caltrans developed open compatibility specifications for a two way communications protocol for Automatic Vehicle Identification including an initial set of Transaction Record Type codes mandated for statewide electronic toll collection use. This standard was Chaptered into the California Code of Regulations in 1992 as Title 21, Chapter 16, Articles 1 through 4, and is commonly referred to as "Title 21".

The Title 21 standard envisioned more complex Transaction Record Type codes being developed for both electronic toll collection and other new applications. To maintain the growth of Title 21 it was specified that Caltrans shall function as the standards monitoring authority to authorize the use of new record types and to assign record type numbers to newly authorized records.

INTENT

This document represents the current Caltrans approved Transaction Record Type codes.

APPROVAL HISTORY

Following is the Approval History of Title 21 Transaction Record Type codes.

	DATE	REQUESTOR	APPROVER	DESCRIPTION
1	7-27-92	Caltrans	California Code of Regulations	Reader and Transponder compatibility specifications with an initial set of Transaction Record Type codes defined for electronic toll collection in California.
2	1-31-97	Texas Instruments	Caltrans	Numerous additional Transaction Record Type codes approved involving lane specific, data transfer and other manufacturer specific information. Message Types were created to further define information exchange.

CALTRANS TECHNICAL CONTACT

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DEFINITION OF TECHNICAL TERMS

Alternative Polling:	A synchronized process where a Reader checks to see if a transponder has arrived by alternatively using a Reader Polling Message with a different Transaction Record Type code.
Approved Codes:	Title 21 Transaction Record Type Codes that have been approved by the California Department of Transportation.
Data Element:	A formalized representation of information. Elements are combined to form a message to provide the information defined by the Transaction Record Type codes.
Data Registration:	A process where the format of all data elements is collected and compiled so that different data assignments remain unique and functionality is defined. It also provides the foundation for regional and interregional interoperability.
Half Duplex:	Data can be transmitted in both directions, but not at the same time.
Message Types:	Message types in this document are used to further define the function and information exchanged between the reader and transponder during each stage of the half duplex communication scheme. There are currently three types defined for the Reader Polling, Transponder Data and Reader Acknowledge messages. The "message types" are specific to this document and do not represent message types (e.g. in Title 21, Type 1 is a poll message) identified in the Title 21 standard. The "type" discrepancy will be clarified in a future Title 21 standard amendment.
Polling:	A synchronized process where a Reader checks to see if a transponder has arrived.
Protocol:	A set of rules or conventions formulated to control the exchange of data between two or more entities.
Reader:	A system, typically in a fixed location, that triggers or activates a transponder, polls the transponder for specific information, and provides an acknowledge message to the transponder after a valid response to the polling message has been received.
Reader Acknowledge Message:	The third and final step in a half duplex communication scheme. Provided to inform specific transponders that they have been successfully processed and can be used to terminate the transaction, or continue processing. It is a specific response to a Transaction Record Type code transmitted during the Transponder Data Message.
Reader Polling Message:	The first step in a half duplex communication scheme. Tells the transponder the type of transaction the reader wishes to conduct by transmission of a Transaction Record Type code.
Title 21 Standard:	California's compatibility specifications for a two way communications protocol for automatic vehicle identification including an initial set of transaction record codes for use in electronic toll collection applications.
Transaction Record Type:	A unique code that specifies the type of valid transaction between a reader and a transponder. This code is transmitted during the Reader Polling, Transponder Data and Reader Acknowledge messages and uniquely defines the function and information exchanged between the reader and transponder.
Transponder:	A typically portable electronic device that contains information which can be communicated to the reader. The transponders may have the capability to read and write information.
Transponder Data Message:	The second step in a half duplex communication scheme. Transponder provides the reader a specific response to a Transaction Record Type code transmitted during the Reader Polling Message.

OVERVIEW OF PROTOCOL:

The California Department of Transportation is providing the following *for informational purposes only*, and assumes *no liabilities* for errors and omissions contained within. It is recommended that you contact your Title 21 system provider to confirm capabilities and ensure that no proprietary implementations or design improvements compromise interoperability with other Title 21 systems.

The currently defined Title 21 protocol is a half duplex communication scheme where the transponder takes its cues from the reader in the following order:

1. Reader Polling Message
2. Transponder Data Message
3. Reader Acknowledge Message.

Each of these three stages of communication has three defined Message Types that further define the function and information exchanged between the reader and transponder.

For complete technical details of the communication protocol refer to this document and to:

- Barclays California Code of Regulations for the Title 21 standard for Reader and Transponder compatibility specifications
- California's Definition for Title 21's Transponder ID Number Field for interoperability assignments within the State.

An overview of this protocol consists of the following ordered bits:

1. READER POLLING MESSAGE:

TYPE	# BITS	DESCRIPTION	HEX VALUE
1	12	Header	Always "AAC"
	16	Transaction Record Type Code	Always "8000"
	16	Agency Code	Undefined
	16	Error Detection Code (CRC 16)	Dependent on Above
	60	Total	
2	12	Header	Always "AAC"
	16	Transaction Record Type Code	Currently Always "80xx"
	16	Agency Code	Undefined
	24	Encode Key (Encryption Proprietary to Texas Instruments)	Proprietary Implementation
	16	Error Detection Code (CRC 16)	Dependent on Above
	84	Total	
3	12	Header	Always "AAC"
	16	Transaction Record Type Code	Currently Always "88xx"
	32	Transponder ID Number	Defined in California and undefined everywhere else
	24	Encode Key (Encryption Proprietary Texas Instruments)	Proprietary Implementation
	8	Error Detection Code (CRC 16)	Dependent on Above
	100	Total	

TRANSPONDER DATA MESSAGE:

TYPE	# BITS	DESCRIPTION	HEX VALUE
1	12	Header	Always "AAC"
	16	Transaction Record Type Code	Always "0001"
	32	Transponder ID Number	Defined in California and undefined everywhere else
	16	Error Detection Code (CRC 16)	Dependent on Above
	76	Total	
2	12	Header	Always "AAC"
	16	Transaction Record Type Code	Currently Always "0007"
	128	Block A Data	System and User Defined
	16	Error Detection Code (CRC 16)	Dependent on Above
	172	Total	
3	12	Header	Always "AAC"
	16	Transaction Record Type Code	Currently Always "000x"
	128	Block A Data	System and User Defined
	128	Block B, C or D Data	System and User Defined
	16	Error Detection Code (CRC 16)	Dependent on Above
	300	Total	

3. READER ACKNOWLEDGE MESSAGE:

TYPE	# BITS	DESCRIPTION	HEX VALUE
1	12	Header	Always "AAC"
	16	Transaction Record Type Code	Always "C000"
	32	Transponder ID Number (Must Match Transmission)	Defined in California and undefined everywhere else
	32	Reader ID Number	Undefined
	16	Transaction Status Code	
	16	Error Detection Code	
	124	Total	
2	12	Header	Always "AAC"
	16	Transaction Record Type Code	Currently Always "C00x"
	16	Agency Code	Undefined
	32	Transponder ID Number (Must Match Transmission)	Defined in California and undefined everywhere else
	16	Reserved	Currently "00" Until Defined
	32	Reader ID Number	Undefined
	16	Transaction Status Code (Activates microprocessor if present when ≥ 8000)	Undefined
	16	Error Detection Code (CRC 16)	Dependent on Above
	156	Total	
3	12	Header	Always "AAC"
	16	Transaction Record Type Code	Currently Always "C00x"
	16	Agency Code	Undefined
	32	Transponder ID Number (Must Match Transmission)	Defined in California and undefined everywhere else
	16	Reserved	Currently "00" Until Defined
	32	Reader ID Number	Undefined
	16	Transaction Status Code (Activates microprocessor if present when ≥ 8000)	Undefined
	128	Data	Undefined
	16	Error Detection Code (CRC16)	Dependent on Above
	284	Total	

There are a number of undefined data elements within the above messages which are summarized as follows

Reader Polling Message:

- Transaction Record Type Code(s) – 16 Bits
- Agency Code(s) – 16 Bits

Transponder Data Message:

- Transaction Record Type Code(s) – 16 Bits
- Transponder ID Number (Currently defined only within California) – 32 Bits

Reader Acknowledge Message:

- Transaction Record Type Code(s) – 16 Bits
- Reader ID Number(s) – 32 Bits
- Transaction Status Code(s) – 16 Bits.

APPROVED TRANSACTION RECORD TYPE CODES

Since Title 21 is an open standard, the functionality of all Approved Transaction Record Type Codes is available for manufacturers to develop interoperable products. However, in some cases (e.g. code functionality affecting account balance on transponders) additional institutional arrangements must be made to avoid potential liability. Please contact Caltrans for further information on developing interoperable products, or to request approval for new Transaction Record Type Codes.

The Caltrans approved Transaction Record Type codes are separated by half duplex communication stage and are summarized as follows:

HALF DUPLEX COMMUNICATION STAGE		TRANSACTION RECORD TYPE CODE (HEX)
1. Reader Polling Message*	25 Total	8000, 8001, 8002, 8003, 8004, 8010, 8011, 8012, 8013, 8014, 8020, 8021, 8022, 8023, 8024, 8030, 8031, 8032, 8033, 8034, 8800, 8801, 8802, 8803, 8804
2. Transponder Data Message*	5 Total	0001, 0002, 0003, 0004, 0007
3. Reader Acknowledge Message*	16 Total	C000, C001, C002, C003, C004, C005, C006, C007, C008, C009, C00A, C00B, C00C, C00D, C00E, C00F

* Please note that with the exception of the interoperable messages 8000, 0001 and C000 the Transaction Record Type codes are specific Texas Instruments product implementations.

TITLE 21 DATA REGISTRATION SURVEY FORM

INTENT

To complete data registration of the Title 21 standard within California and to extend the registration process to include operational Title 21 facilities outside of California, related equipment manufacturers and system integrators. Participation in this process provides a mechanism for Title 21 data definitions to remain unique, and can provide the foundation for regional and interregional interoperability.

A survey form is included to complete data registration of the following undefined elements:

Reader Polling Message:

- Transaction Record Type Code(s) – 16 Bits
- Agency Code(s) – 16 Bits

Transponder Data Message:

- Transaction Record Type Code(s) – 16 Bits
- Transponder ID Number (Currently defined only within California) – 32 Bits

Reader Acknowledge Message:

- Transaction Record Type Code(s) – 16 Bits
- Reader ID Number(s) – 32 Bits
- Transaction Status Code(s) – 16 Bits.

INSTRUCTIONS FOR FILLING OUT SURVEY FORM

The following data registration survey form is intended to be filled out by a technical person familiar with the communication protocols of your Title 21 based system.

The survey presents questions divided by each of the three defined stages of communication, the **Reader Polling**, **Transponder Data** and **Reader Acknowledge** Messages. Questions are further subdivided to record information on your current mode of system operation, as well as the full capabilities of your system.

To establish a common baseline of understanding, the questions follow the bit ordered half duplex communication scheme defined in the "Overview of Protocol" section of the Caltrans approved Title 21 Transaction Record Type Codes. Please refer to this document, which was included as an attachment, when completing the "Response" sections of this survey form.

If additional space is required for any responses include them on the attached "Additional Information Sheet" which is provided at the end of the survey.

After completing the survey please mail it to Caltrans in the provided envelope. A prompt response is greatly appreciated.

Please feel free to contact David Cordone of Caltrans' Office of ITS Projects and Standards at 916.653.4670, or by email at david_cordone@dot.ca.gov, for any other technical assistance in completing this Title 21 data registration survey form.

-- BEGIN SURVEY --

AGENCY:

MAILING ADDRESS:

TECHNICAL CONTACT NAME:

**TECHNICAL CONTACT EMAIL
ADDRESS:**

TECHNICAL CONTACT PHONE # :

1. READER POLLING MESSAGE - Current Mode Of Operation

QUESTION		RESPONSE		
1	Indicate which of the three approved Message Types are in operation by circling the number(s) to the right. If "NONE" consider contacting Caltrans for information on approval. (Refer to Page 3*)	1	2	3
		NONE		
2	Is your system alternatively polling using different Transaction Record Type codes? If "YES" please list all types in question 3 below. (Refer to Page 6*)	NO		YES
3	Which Caltrans approved Transaction Record Type code(s) are being utilized? If your system utilizes a Transaction Record Type code(s) not approved by Caltrans consider contacting Caltrans for information on approval. (Refer to Page 6*)			
4	Does your system utilize more than one Agency Code? If "YES" please list all types in question 5 below. (Refer to Page 3*)	NO		YES
5	What is the syntax of the 16-bit Agency code(s) being transmitted? Please indicate whether the format is in binary, decimal or hexadecimal notation. (Refer to Page 3*)			

* The referenced page numbers correspond to the attached *Caltrans Approved Title 21 Transaction Record Type Codes*

READER POLLING MESSAGE - Capabilities of System

QUESTION		RESPONSE		
6	Indicate which of the three approved Message Types can be used by your system by circling the number(s) to the right. If "NONE" consider contacting Caltrans for information on approval. (Refer to Page 3*)	1	2	3
			NONE	
7	Can your system support alternatively polling using different Transaction Record Type codes? If "YES", please list all types in question 8 below. (Refer to Page 6*)	NO		YES
8	Which Caltrans approved Transaction Record Type code(s) can your system support? If your system utilizes a Transaction Record Type code(s) not approved by Caltrans consider contacting Caltrans for information on approval. (Refer to Page 6*)			
9	Can your system utilize more than one Agency Code? If "YES" please list all types in question 10 below. (Refer to Page 3*)	NO		YES
10	What is the syntax of the 16-bit Agency Code(s) that can be transmitted? Please indicate whether the format is in binary, decimal or hexadecimal notation. (Refer to Page 3*)			

* The referenced page numbers correspond to the attached *Caltrans Approved Title 21 Transaction Record Type Codes*.

2. TRANSPONDER DATA MESSAGE - Current Mode Of Operation

QUESTION		RESPONSE		
11	Indicate which of the three approved Message Types are in operation by circling the number(s) to the right. If "NONE" consider contacting Caltrans for information on approval. (Refer to Page 4*)	1	2	3
		NONE		
12	Which Caltrans approved Transaction Record Type code(s) are being utilized by your transponders? If your system utilizes a Transaction Record Type code(s) not approved by Caltrans consider contacting Caltrans for information on approval. (Refer to Page 6*)			
13	Is your system only utilizing the Title 21 transponder in a read only application?	NO	YES	
14	What is the syntax of the 32-bit Transponder ID Number field used in your system? Please indicate whether the format is in binary, decimal or hexadecimal notation. Disregard question if your Transponder ID is already defined in California. (Refer to Page 4*)			
15	What is the range of Transponder ID Numbers used in your system? Please indicate whether the format is in binary, decimal or hexadecimal notation. Disregard question if your Transponder ID is already defined in California.			

* The referenced page numbers correspond to the attached *Caltrans Approved Title 21 Transaction Record Type Codes*.

TRANSPONDER DATA MESSAGE - Capabilities of System

QUESTION		RESPONSE
16	Indicate which of the three approved Message Types your system can support circling the number(s) to the right. If "NONE" consider contacting Caltrans for information on approval. (Refer to Page 4*)	<div>1 2 3</div> <div>NONE</div>
17	Which approved Transaction Record Type code(s) can your system support? If your system utilizes a Transaction Record Type code(s) not approved by Caltrans consider contacting Caltrans for information on approval. (Refer to Page 6*)	

* The referenced page numbers correspond to the attached *Caltrans Approved Title 21 Transaction Record Type Codes*.

3. READER ACKNOWLEDGE MESSAGE - *Current Mode Of Operation*

QUESTION		RESPONSE		
18	Indicate which of the three approved Message Types are in operation by circling the number(s) to the right. If "NONE" consider contacting Caltrans for information on approval. (Refer to Page 5*)	1	2	3
			NONE	
19	Which Caltrans approved Transaction Record Type code(s) are being utilized? If your system utilizes a Transaction Record Type code(s) not approved by Caltrans consider contacting Caltrans for information on approval. (Refer to Page 6*)			
20	What is the syntax of the 32-bit Reader ID Number field used in your system? Please indicate whether the format is in binary, decimal or hexadecimal notation. (Refer to Page 5*)			
21	What is the range of Reader ID Numbers used in your system? Please indicate whether the format is in binary, decimal or hexadecimal notation.			

* The referenced page numbers correspond to the attached *Caltrans Approved Title 21 Transaction Record Type Codes*.

READER ACKNOWLEDGE MESSAGE - Current Mode Of Operation

QUESTION		RESPONSE
22	Are Transaction Status Codes currently used in your system? If "YES" please answer questions 23 and 24 below, if "NO" move to question 25. (Refer to Page 5*)	<div>NO</div> <div>YES</div>
23	If Transaction Status Codes are currently used in your system identify the syntax and define the functionality. Please indicate whether the format is in binary, decimal or hexadecimal notation. Since no status codes are currently defined, consider contacting Caltrans for information on approval. (Refer to Page 5*)	
24	If Transaction Status Codes are currently used in your system identify the range. Please indicate whether the format is in binary, decimal or hexadecimal notation. Since no status codes are currently defined, consider contacting Caltrans for information on approval.	

* The referenced page numbers correspond to the attached *Caltrans Approved Title 21 Transaction Record Type Codes*

READER ACKNOWLEDGE MESSAGE - Capabilities of System

QUESTION		RESPONSE
25	Indicate which of the three approved Message Types your system can support. If your system utilizes a message format that is different than those identified on the listing of Caltrans approved Transaction Record Type Codes consider contacting Caltrans for information on approval.	<div>1 2 3</div> <div>NONE</div>
26	Which Caltrans approved Transaction Record Type code(s) can your system support? If your system can utilize a Transaction Record Type code(s) not approved by Caltrans consider contacting Caltrans for information on approval.	
27	Can your system support the use of Transaction Status Codes? If "YES" please answer questions 28 and 29 below, if "NO" the survey is complete. Thank you.	<div>NO YES</div>
28	If Transaction Status Codes can be used in your system identify the syntax. Please indicate whether the format is in binary, decimal or hexadecimal notation. Since no status codes are currently defined, consider contacting Caltrans for information on approval.	
29	If Transaction Status Codes can be used in your system identify the range. Please indicate whether the format is in binary, decimal or hexadecimal notation. Since no status codes are currently defined, consider contacting Caltrans for information on approval.	

**- END SURVEY -
THANK YOU**

ADDITIONAL INFORMATION SHEET

QUESTION	RESPONSE